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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/564,846	06/30/2006	Laurent Karsenti	4006317-0072-002	3155
57605 7590 05/06/2009 APPLIED MATERIALS, INC. C/O SONNENSCHN NATH & ROSENTHAL LLP P.O. BOX 061080 WACKER DRIVE STATION, SEARS TOWER CHICAGO, IL 60606-1080				
EXAMINER				
SHIKHMAN, MAX				
ART UNIT		PAPER NUMBER		
2624				
MAIL DATE		DELIVERY MODE		
05/06/2009		PAPER		

**Please find below and/or attached an Office communication concerning this application or proceeding.**

The time period for reply, if any, is set in the attached communication.

### Office Action Summary

**Application No.**

10/564,846

**Applicant(s)**

KARSENTI, LAURENT

**Examiner**

MAX SHIKHMAN

**Art Unit**

2624

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --  
**Period for Reply**

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

**Status**

- 1) ☒ Responsive to communication(s) filed on 17 March 2009.
- 2a) ☐ This action is **FINAL**. 2b) ☒ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

**Disposition of Claims**

- 4) ☒ Claim(s) 1, 13-18, 20-25, 27-31, 33-39, 41 and 42 is/are pending in the application.
- 4a) Of the above claim(s) \_\_\_\_\_ is/are withdrawn from consideration.
- 5) ☐ Claim(s) \_\_\_\_\_ is/are allowed.
- 6) ☒ Claim(s) 1, 13-18, 20-25, 27-31, 33-39, 41 and 42 is/are rejected.
- 7) ☐ Claim(s) \_\_\_\_\_ is/are objected to.
- 8) ☐ Claim(s) \_\_\_\_\_ are subject to restriction and/or election requirement.

**Application Papers**

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☐ The drawing(s) filed on \_\_\_\_\_ is/are: a) ☐ accepted or b) ☐ objected to by the Examiner.  
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).  
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

**Priority under 35 U.S.C. § 119**

- 12) ☐ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☐ All b) ☐ Some \* c) ☐ None of:
1. ☐ Certified copies of the priority documents have been received.
  2. ☐ Certified copies of the priority documents have been received in Application No. \_\_\_\_\_.
  3. ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

\* See the attached detailed Office action for a list of the certified copies not received.

**Attachment(s)**

- 1) ☒ Notice of References Cited (PTO-892)
- 2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
- 3) ☐ Information Disclosure Statement(s) (PTO/SB/08)  
Paper No(s)/Mail Date \_\_\_\_\_
- 4) ☐ Interview Summary (PTO-413)  
Paper No(s)/Mail Date \_\_\_\_\_
- 5) ☐ Notice of Informal Patent Application
- 6) ☐ Other: \_\_\_\_\_

***Response to Amendment***

1. Applicants' response to the last Office Action, filed 03/17/2009 has been entered and made of record.

***Response to Arguments***

2. Applicant argues: Nowhere in Qu is a discussion of a minimum distance between objects, much less a structuring element that is at least one of smaller and equal to a minimum distance between objects in the SEM image.

Reply: Applicant placed cancelled claims 19, 26, 32 and 40, that is at least one of smaller and equal to a minimum distance between objects in the SEM image, into independent claims. Because a new Gonzalez reference is added to address amended independent claims, this action is non-final.

***Claim Rejections - 35 USC § 103***

3. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negated by the manner in which the invention was made.

4. Claim 1,27,33; 16,24,29,37; 17,30,38; 18,31,39; 20,41; 21,42; 22,23 rejected under 35 U.S.C. 103(a) as being unpatentable over

GONGYUAN Qu "Wafer Defect Detection Using Directional Morphological Gradient Techniques" in view of

Rafael C. Gonzalez, "Digital Image Processing, 2/E" ISBN: 0201180758.

**() Regarding Claims 1,27,33:**

(Qu: SEM=P687 col1. shift-invariant=[0025] Morphology...shift invariant

morphological operation=P688 "directional morphological gradient (DMG)"

idealized image=Fig8 b,f,d,h. Fig15 c,f,i,l. Fig14 DMG7

detect a defect= P698, "gradient method has been presented and applied to the automatic detection and isolation of particle, spot, and scratch defects")

1. (Currently Amended) A method, comprising applying a morphological operation to an SEM image to obtain a idealized image, the morphological operation being an image processing operation using shift-invariant operators and the idealized image having fewer details than the SEM image; (Fig8 b,f,d,h. Fig15 c,f,i,l. Fig14 DMG7, fewer details due to smoothing and morphology.)

wherein the morphological operation makes use of a structuring element (Qu P688 col1 two smaller structuring elements B1 and B2. P687 col2, "The structuring element has a size and shape appropriate for the geometric features of interest." P689 col1 "noise sensitivity, which increases as the size, in pixels, of the structuring element increases". Fig1.)

and using the idealized image to detect a defect in a subject of the SEM image. (Title. P698, "DMG to have a stronger response to the defect". "gradient method has been presented and applied to the automatic detection and isolation of particle, spot, and scratch defects")

Qu discloses everything as described above except, that is at least one of smaller and equal to a minimum distance between objects in the SEM image.

Gonzalez discloses as follows. p525 Ex9.1, The "*maximum length of the breaks is ...two pixels*", breaks are within a single letter; the distance between letters in Fig9.5 should be bigger. The structuring element in Fig9.5b is 3x3, is 1 pixel bigger than the maximum 2 pixel breaks within each letter, but smaller than breaks/distance between letters. Each letter is an individual object.

Gonzalez P527, "structuring element of a size smaller than the objects we...keep". As Gonzalez discloses, it is desirable for a structuring element to be just one pixel bigger than the biggest object to remove, so as not to remove anything else. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention, to use Gonzalez method, use a structuring element only as big as the biggest object to remove, in the method of Qu--size and shape appropriate for the geometric features of interest-- "one of smaller and equal to a minimum distance between objects in the SEM image", would be obvious to try, to keep the objects visually distinct, not to smudge objects onto each other with structuring element bigger than the distance between objects.

**() Regarding Claims 16,24,29,37:**

16. (New) The method of claim 1, wherein the morphological operation comprises at least one of: erosion, dilation, opening, closing, shrinking, thinning, thickening, skeletonization, and pruning. (P688, formula 7. erosion.)

**() Regarding Claims 17,30,38:**

17. (New) The method of claim 1, wherein the morphological operation comprises a sequence of morphological operations. (P688, formula 7. dilation then erosion)

**() Regarding Claims 18,31,39:**

18. (New) The method of claim 1, wherein the morphological operation makes use-of structuring elements that match one or more morphological properties of a pattern present in the SEM image. (P689 "These two edge models are applicable to defect detection because the design pattern will consist primarily of sharp well-defined edges.")

**() Regarding Claims 20,41:**

20. (New) The method of claim 1, wherein the morphological operation makes use of structuring elements that do not match one or more morphological properties of a pattern present in the SEM image. (P687, "irregular defect edges". P698 "very small defect against a high contrast pattern structure.")

**() Regarding Claims 21,42:**

21. (New) The method of claim 1, wherein at least some patterns present in the SEM image are modified by the morphological operation while other patterns present in the SEM image are not modified by the morphological operation. (fig 9. P695 col1 "some loss of the defect definition while parts of the design pattern remain.")

**() Regarding Claim 22:**

(Qu: SEM=P687 col1. shift-invariant=[0025] Morphology...shift invariant

morphological operation=P688 "directional morphological gradient (DMG)"

idealized image=Fig8 b,f,d,h. Fig15 c,f,i,l. Fig14 DMG7

detect a defect= P698, "gradient method has been presented and applied to the automatic detection and isolation of particle, spot, and scratch defects"

All limitations of Claim 21 disclosed in claim 22.)

22. (New) A method, comprising applying a sequence of morphological operations to an image, the morphological operations making use of structuring elements that match or do not match some morphological properties of a pattern present in the image, and (Section 3.1 DMG. P692 "pattern structures")

detecting defects in a subject of the image as a consequence of some of said patterns being modified by the morphological operations while others are not. (fig 9. P695 col1 "some loss of the defect definition while parts of the design pattern remain.")

**() Regarding Claim 23:**

23. (New) The method of claim 22, wherein the morphological operations use translation invariant operators. [Applicant defines morphology as translation invariant. [0025] Morphological image processing may be regarded generally, as binary or other (e.g., grayscale) image processing using shift-invariant (translation invariant) operators. Qu is using morphology also.]

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5. Claims 13, 34; 14,25,28,35; 15,36; rejected under 35 U.S.C. 103(a) as being unpatentable over

GONGYUAN Qu "Wafer Defect Detection Using Directional Morphological Gradient Techniques" in view of

Chetverikov "Finding defects in texture using regularity and local orientation"

**() Regarding Claim 13:**

(Qu: SEM=P687 col1. shift-invariant=[0025] Morphology...shift invariant  
morphological operation=P688 "directional morphological gradient (DMG)"  
idealized image=Fig8 b,f,d,h. Fig15 c,f,i,l. Fig14 DMG7)

Qu discloses everything as described above except image comparison.

Chetverikov discloses,

defect is detected (P2170 col1, "top-hat image can then be thresholded to locate the position of the defect.") by image comparison (P2169 formula 3, "top hat", "difference between I and its opening") between the... image (formula3: I) and the idealized image.  
(formula3:  $\gamma_B I$ )

As Chetverikov discloses, it is desirable to compare images using morphological top hat for defect detection. Therefore, it would have been obvious to one of ordinary skill in the art at the time of the invention, to use Chetverikov top hat thresholding in Qu's SEM defect detection; this enhances Qu's method.

**() Regarding Claim 14,25,28,35:**

14. (New) The method of claim 13, wherein the image comparison comprises subtraction such that an image obtained after the morphological operation reveals only details that have been removed by the morphological operation.

(All limitations of claim 14 disclosed in claim 13. Subtraction is formula 3.)



**() Regarding Claim 15,36:**

15. (New) The method of claim 13, wherein the comparison comprises a thresholding operation.  
(All limitations of claim 14 disclosed in claim 13. P2170 co1, "top-hat image can then be thresholded to locate the position of the defect.")

**() Regarding Claim 34:**

All limitations of Claim 34 disclosed in claim 13.

***Conclusion***

6. Any inquiry concerning this communication or earlier communications from the examiner should be directed to MAX SHIKHMAN whose telephone number is (571)270-1669. The examiner can normally be reached on Monday-Friday 8:30AM-6:00PM EST.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, JINGGE WU can be reached on (571) 272-7429. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Max Shikhman/  
Examiner, Art Unit 2624  
4.30.2009

/Vikkram Bali/  
Supervisory Patent Examiner, Art Unit 2624